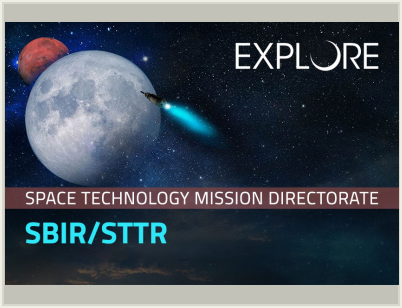
# Molecular Air Data Clear Air Turbulence Sensor: MADCAT, Phase I

Completed Technology Project (2010 - 2010)

## Project Introduction

Clear air turbulence (CAT), often referred to as "air pockets," is attributed to Kelvin-Helmholtz instabilities at altitudes generally above 18,000ft, often in the absence of any visual cues such as clouds, making it difficult to avoid. The vortices produced when atmospheric waves "break" can have diameters of 900-1200ft and tangential velocities of 70-85 ft/sec. CAT is dangerous for commercial and military aviation, most recently demonstrated by Continental flight 128 from Rio de Janeiro to Houston on August 3, 2009, which encountered severe turbulence and made an emergency landing with 37 injured passengers, nine hospitalized. Many other incidents attributed to turbulence have caused injuries or deaths to passengers and crew. Another recently-highlighted hazard is the inadequacy of current airspeed sensors on commercial aircraft. Federal investigators have reported that on at least a dozen recent flights by U.S. jetliners, malfunctioning equipment made it impossible for pilots to know how fast they were flying. Michigan Aerospace Corporation (MAC) proposes the Molecular Air Data and Clear Air Turbulence (MADCAT) system which will be capable of providing not only a look-ahead capability to predict clear air turbulence but also a full air data solution (airspeed, angle of attack, angle of sideslip, pressure and temperature). The technology has already demonstrated, in-flight, the ability to measure airspeed, angle of attack and angle of sideslip. In addition, ground units based upon the same core technology have demonstrated range-resolved wind, temperature and density measurements from the ground to altitudes of 18km. This proposal will focus on combining the two capabilities into a practical solution. MAC's direct-detection UV LIDAR technology uses molecular backscatter and so does not require aerosols, as required by many competing approaches.

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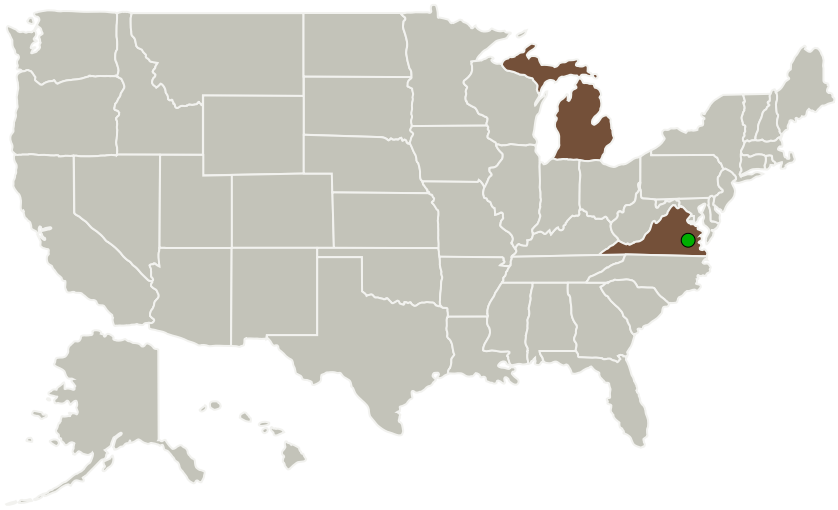
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Michigan Aerospace Corporation | Lead Organization | Industry | Ann Arbor, Michigan |
| Langley Research Center(LaRC) | Supporting Organization | NASA Center | Hampton, Virginia |

| Primary U.S. Work Locations | |
|---|---|
| Michigan | Virginia |

## Project Transitions

**January 2010:** Project Start

**July 2010:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/139919)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Michigan Aerospace Corporation

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

Dominique Fourguette

**Co-Investigator:**

Dominique Fourguette

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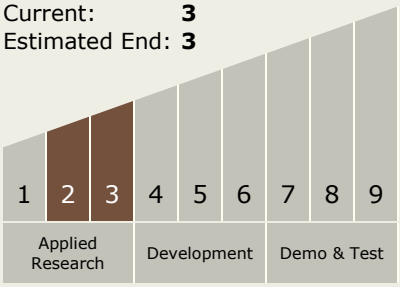
## Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**




## Technology Areas

**Primary:**

- TX16 Air Traffic Management and Range Tracking Systems
  - TX16.6 Integrated Modeling, Simulation, and Testing

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System